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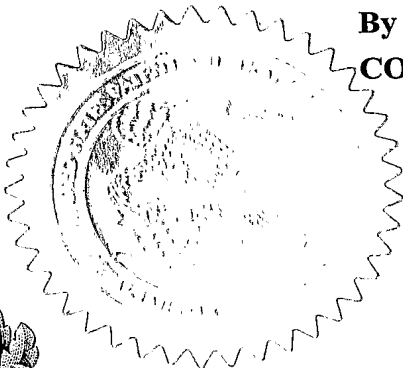
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Additional inventors are being named on the _____ separately numbered sheets attached hereto					
TITLE OF THE INVENTION (500 characters max)					
PROCESS FOR PRODUCING IRON ORE AGGLOMERATES					
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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.					
<input checked="" type="checkbox"/> No.					
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[Page 1 of 2]

Respectfully submitted,

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PROCESS FOR PRODUCING IRON ORE AGGLOMERATES

The invention relates to a process for producing iron ore agglomerates.

- 5 The object of the present invention is to provide iron ore agglomerates with improved physical properties.

The present invention provides a process for producing iron ore agglomerates comprising agglomerating fine iron ore particles in the presence of a binder system
10 wherein the binder system comprises a binder and an alkali metal silicate, and wherein the alkali metal silicate is present in an amount of between 0.0001 to 0.07 percent by weight, based on the total weight of dry iron ore agglomerate wherein the binder system is free of synthetic polymer. The process of the invention leads to iron ore agglomerates with an increased dry strength, preheat strength, and dry
15 crush strength relative to the use of conventional binder systems comprising the same binder. Furthermore, small amounts of the alkali metal silicate are already sufficient to obtain a significant improvement in the physical properties of the agglomerates.

- 20 The amount of alkali metal silicate is preferably between 0.001 and 0.065 percent by weight, and most preferably between 0.005 and 0.06 percent by weight, based on the total weight of dry iron ore agglomerate. With "dry iron ore agglomerate" is meant the total of all ingredients except water used in the formation of the iron ore agglomerate.

25

The alkali metal silicate is usually a sodium silicate, but other alkali metal silicates can be used. Examples of sodium silicates are sodium metasilicate and the commercially available Waterglass. Waterglass is most preferred. In the sodium

silicates, the molar ratio $\text{Na}_2\text{O}:\text{SiO}_2$ is generally in the range of 2:1 to 1:5, preferably in the range of 1:2 to 1:3. The amount of alkali metal silicate in the binder system is generally at least 1 wt%, preferably at least 10 wt%, and most preferably at least 15 wt%, and generally at most 99 wt%, preferably at most 90 wt%, and most preferably
5 at most 85 wt%, based on total weight of the binder system.

The alkali metal silicate preferably is well dispersed in the particles to be agglomerated. The silicate can be added to the iron ore particles in the form of a dry powder, an aqueous suspension, an aqueous solution, etc. Preferably, the alkali
10 metal silicate is added in the form of an aqueous solution.

The binder in the binder system of the invention can be an inorganic binder or an organic binder, or a mixture thereof. Examples of an inorganic binder are bentonite and hydrated lime. Examples of organic binders are polymers including:
15

(1) Water-soluble natural polymers, such as guar gum, starch, alginates, pectins, xanthan gum, dairy wastes, wood related products, lignin and the like;

(2) Modified natural polymers such as guar derivatives (e.g. hydroxypropyl guar, carboxymethyl guar, carboxymethylhydroxypropyl guar), modified starch (e.g.
20 anionic starch, cationic starch), starch derivatives (e.g. dextrin) and cellulose derivatives, such as alkali metal salts of carboxymethyl cellulose, hydroxyethyl cellulose, hydroxypropyl cellulose, carboxymethylhydroxyethyl cellulose, methyl cellulose, lignin derivatives (e.g. carboxymethyl lignin), and the like; and/or
25

The foregoing polymers may be used alone or in various combinations of two or more polymers.

The binder system is free of synthetic polymers. Examples of synthetic polymers are polyacrylamides, such as partially hydrated polyacrylamides, methacrylamide and polymethacrylamide, polyacrylates and copolymers thereof; polyethylene oxides, and the like.

5

A further aspect of the present invention is a process for producing iron ore agglomerates comprising agglomerating fine iron ore particles in the presence of a binder system wherein the binder system comprises carboxymethyl cellulose or a salt thereof and an alkali metal silicate. The use of the combination of
10 carboxymethyl cellulose and alkali metal silicate leads to agglomerates with increased physical properties, such as dry pellet strength, preheat strength and dry crush strength. In addition, the reducibility of the iron in the agglomerates is similar or even higher than observed when either CMC or alkali metal silicate alone is used as binder.

15

The invention further concerns a binder system comprising carboxymethyl cellulose and an alkali metal silicate. The amount of alkali metal silicate in the binder system is generally at least 1 wt%, preferably at least 10 wt%, and most preferably at least 15 wt%, and generally at most 99 wt%, preferably at most 90 wt%, and most
20 preferably at most 85 wt%, based on total weight of the binder system.

The carboxymethyl cellulose or the salt thereof (both are referred to as "CMC") are preferably substantially water-soluble. Preferred salts of carboxymethyl cellulose are alkali metal salts of carboxymethyl cellulose. Of these alkali metal salts the sodium salt is preferred. The CMC used in the present invention generally has a
25 degree of substitution (the average number of carboxymethyl ether groups per repeating anhydroglucose chain unit of the cellulose molecule) of at least 0.4, preferably at least 0.5, and most preferably at least 0.6, and at most 1.5, more

preferably at least 1.2, and most preferably at most 0.9. Generally, the average degree of polymerization of the cellulose furnish is at least 50, preferably at least 250, and most preferably at least 400, and generally at most 8,000, preferably at most 7,000, and most preferably at most 6,000. It is more preferred to use sodium
5 carboxymethyl cellulose having a Brookfield viscosity in a 1% aqueous solution of more than 2,000 cps at 30 rpm, spindle #4. Still more preferred is sodium carboxymethyl cellulose having a Brookfield viscosity in a 1% aqueous solution of more than about 4,000 cps at 30 rpm, spindle #4.

- 10 A series of commercially available binders containing sodium carboxymethyl cellulose especially useful in the present invention is available from Akzo Nobel, under the trademark PeridurTM.

The manner in which the binder is added to the particulate material depends on the
15 type of material being agglomerated, the type of binder being used, and the desired results. For example, the binder may be added as a dry powder, an aqueous suspension, an aqueous solution, an aqueous gel, an aqueous sol (colloidal system), etc.

- 20 The amount of binder employed also varies with the results desired. For example, when an organic binder is used, the amount of binder may range from 0.0025 to 0.5 wt.%, based on the weight of the particulate material, with a preferred range being 0.005 to 0.2 wt.%. In the case of an inorganic binder, the amount of binder may range for example from 0.1 to 3 wt.%, based on the weight of the particulate
25 material.

The binder and the alkali metal silicate can be added to the iron ore particles together, one after the other, etc. This is not critical, so long as care is taken that when the agglomeration takes place, the binder and the additive are present to perform.

5

The process of the invention is useful in agglomerating fine iron ore particles. It is particularly suitable to use the process of the invention in agglomerating iron ores that are generally difficult to process with known binder systems. The invention is however not limited to iron ores, and is also useful in the agglomeration of fine
10 particles of other metal ores. This invention is particularly well adapted for the agglomeration of materials containing iron, including iron ore deposits, ore tailings, cold and hot fines from a sinter process or aqueous suspensions of iron ore concentrates from natural sources or recovered from various processes. Iron ore or any of a wide variety of the following minerals may form a part of the material to be
15 agglomerated: taconite, magnetite, hematite, limonite, goethite, siderite, franklinite, pyrite, chalcopryite, chromite, ilmenite, and the like.

The size of the material being agglomerated varies according to the desired results. For example, when the particulate material being agglomerated is iron ore, 100% of
20 the particles may be less than 80 mesh, preferably, 90% are less than 200 mesh, and most preferably, 75% are less than 325 mesh.

It is also envisaged to use conventional additives, such as a base like sodium hydroxide, soda, or other additives like sodium citrate, sodium oxalate, etc. These
25 additives, their purpose and their use are known to the skilled person.

Many processes for the agglomeration of particles, especially metal-based particles, are known in the art. Examples of such processes are pelletization, briquetting, sintering etc. The binder system used in accordance with the invention is particularly suitable for pelletization. In the mining industry it is common practice to
5 agglomerate or pelletize finely ground beneficiated mineral ore concentrate to facilitate processing and handling/shipping of the ore. After the mineral ore has been mined, it is frequently wet ground to liberate and separate unwanted gangue minerals from the desired material, e.g. iron in the case of iron ore. The processed wet ground ore is screened to remove large particles which can be recycled for
10 further grinding. The screened fines are then vacuum filtered to reduce the moisture content to an acceptable range for pelletization. The filtered mineral ore is known in the art as "concentrate". A second process involves "dry grinding" and beneficiation of the mineral ore, in which case the moisture required for pelletization is added afterwards.

15 After beneficiation, a binding agent is added to the wetted mineral ore concentrate and the binder/mineral ore composite is conveyed to a balling drum or other means for pelletizing the ore. The binding agent serves to hold or bind the mineral ore together, so that the individual agglomerates can be transported without losing their
20 integrity en route to further processing and induration.

Following the balling drum operation, the pellets are formed, but they are still wet. These wet pellets are commonly referred to as "green pellets" or "green balls". These green pellets are thereafter transported to a kiln and heated in stages to an
25 end temperature of about 1,300-1,350°C. In the pelletizing process, the wet green pellets are loaded into the furnace for further processing. The moisture in the pellets is removed by induration at temperatures normally between 400-600°C. Following

drying in the furnace, the pellets are transported to the preheat zone. This is an additional heating stage to further increase the pellets' hardness before they are transported to the kiln and/or final firing stage. Heating generally occurs at 900-1,200°C to bind the pellet together (e.g. to oxidize magnetite or crystallize hematite).

- 5 From the preheat zone, the pellets are dropped 10-15 feet from the grate to the kiln. This is where the preheat strength is needed to prevent the pellets from chipping and breaking apart into dust particles. Finally, the preheated pellets are fired at a temperature of between 1,300 and 1,350 °C.

- 10 The ability of the pellets to withstand breakage throughout processing can be approximated by performing standard tests that measure the strength (e.g. wet pellet strength, dry pellet strength, preheat strength, and dry crush strength) the pellets will have/need at each stage of processing.

WE CLAIM:

1. A process for producing iron ore agglomerates comprising agglomerating fine iron ore particles in the presence of a binder system wherein the binder system
5 comprises a binder and an alkali metal silicate, and wherein the alkali metal silicate is present in an amount of between 0.0001 to 0.07 percent by weight, based on the total weight of dry iron ore agglomerate, wherein the binder system is free of synthetic polymer.
- 10 2. A process for producing iron ore agglomerates comprising agglomerating fine iron ore particles in the presence of a binder system wherein the binder system comprises carboxymethyl cellulose and an alkali metal silicate.
3. A binder system comprising carboxymethyl cellulose and an alkali metal
15 silicate.